SYSTEMS ENGINEERING LABORATORIES, INCORPORATED

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SCO 2055-6980

National Aeronautics and Space Administration
George C. Marshall Space Flight Center
Huntsville, Alabama 35812

Attention: Mr. H. Ronald Greene, PR-RC
Contract Administrator

Subject: Contract NAS 8-11584
Second Quarterly Report

Gentlemen:

This quarterly report of progress covers the reporting period ending 17 October 1964. Copies of engineering drawings will be forwarded as soon as they become available.

1.0 SUMMARY

All major items were received this quarter with the exception of the AC-DC converters manufactured by North Atlantic Industries. These converters have been rescheduled twice this quarter due to non-delivery by North Atlantic. The latest delivery estimate of these converters is 5 November 1964.

Two design review meetings were held this quarter with MSFC representatives. It was decided that the patchboards would use two conductor shielded patchcords instead of the single shielded conductor originally specified. This will allow a greater number of channels to be brought in to the patchboards and at the same time reduce the number of patches required. The patchcords have been ordered for this and are of the locking, twin detent, manual extraction type.

The AC and DC measurements for the relay multiplexer were split into two groups after relay evaluation showed this to be the most reliable method.

System design was essentially completed this period with the exception of those parts dealing with the AC to DC converters and the limits to be set on the alarm circuits. These limits are to be supplied to the project as soon as defined by MSFC.

Fabrication of printed circuit cards is taking somewhat longer than anticipated due to the use of MSFC standard 158B and 154. Cards to be manufactured for spare parts will therefore not be started until system cards are complete. Cards for the system should be completed by 1 December 1964.

At the present time the project is still slightly ahead of schedule and no delivery problems can be foreseen.

2.0 TEST RESULTS

Relay testing was completed this period with the following results:

Relay Sample 1

Manufacturer	-	Clare
Type	-	Dry Reed
Model Number	-	CR3Z

This relay was evaluated to determine characteristics which would make it desirable for use in the system. The relay was operated at various rates with square wave drive. As the frequency was increased several resonances were noticed before reaching a 200 sample per second rate. These resonances were due in part to the length of the armature used and also to the fact that damping measures were insufficient. Voltage tests made on the relay indicate that it is capable of withstanding voltages in excess of 250 volts. This voltage, however, was considered to be the practical limit due to manufacturers specifications. The basic test characteristics of the relay are tabulated as follows:

1.	Operate Time	1.2 milliseconds nominal
2.	Bounce Time	200-500 microseconds
3.	Release Time	500 microseconds nominal
4.	Operating Rate	$<$ 100 samples per second
5.	Voltage Breakdown	$>$ 250 volts

Relay Sample 2

It was decided to determine if a relay could be produced with additional damping to provide greater operating speed. It was also requested that the armature be shortened to relieve the resonances that occur due to the original length.

After discussion with representives of Clare, a second relay was obtained which incorporated dimpling in the glass bulb to restrain the armature on its releasing movement. A slight increase in operating speed was noticed but 400 samples per second operation was not feasible.

Relay Sample 3

Manufacturer	-	Struthers-Dunn
Type	-	Dry Reed

This relay was tested to provide information on a dry reed type relay with shorter armature than could be obtained from Clare.

The results of testing indicated the following:

1.	Operate Time	1.0 milliseconds
2.	Bounce Time	350 microseconds nominal
3.	Release Time	150 microseconds nominal
4.	Operating Rate	150 samples per second maximum
5.	Voltage Breakdown	$>$ 250 volts

This relay was faster than the Clare but again the operating speed did not approach the desired 400 samples per second. Resonances occurred at the higher operating rates which limited the relay in its operating capability.

Relay Sample 4

Manufacturer	-	James
Type	-	High Speed Micro-scan
Model	-	C-4680

This relay was thoroughly tested under various operating conditions and was additionally life tested. The relay contains a form-K contact arrangement which provides a center stable off condition and thus a break before make feature. This allows five channels to be placed on the same relay.

The following table states the essential characteristics as determined from tests:

1.	Operate Time	0.75 - 1 millisecond
2.	Bounce Time	Not noticeable
3.	Release Time	350-500 microseconds
4.	Operating rate	0-600 samples per second
5.	Voltage Breakdown	< 200 volts varies between contacts
6.	Life (Standard model)	200,000,000 operations
7.	Live Expectancy (Deluxe Model)	One Billion Operations

The life test on the relay was run with various voltages applied at different times as might be found in actual operation. These voltage ranged from 1 to 60 volts normally, with occasional increases to 200 volts to check breakdown. End of life was determined by relay failure on any one contact; however, readjustment of the contacts may be done by removal of the relay and subsequent placement in test cell. After readjustment the relay was again operated. The above test, therefore, does not indicate life time but time to failure.

The relay was determined not to be satisfactory if voltages greater than 100 volts were to be switched.

Conclusions:

It was decided that to provide the greatest amount of reliability and operating flexibility that the AC and DC measurement busses be separated. Since the AC measurements are high voltage measurements, i.e. above 200 volts peak 150 volts RMS, and the settling time is 100 milliseconds for a measurement, the Clare relay was determined to be suitable. All DC measurements below 60 volts will use the James Microscan relay which will provide the required 400 samples per second rate.

If there are any questions concerning this report, please contact Mr. K. R. Grice of our firm at your convenience.

Yours very truly,

SYSTEMS ENGINEERING LABORATORIES, INCORPORATED

A. G. Randolph, Vice President
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